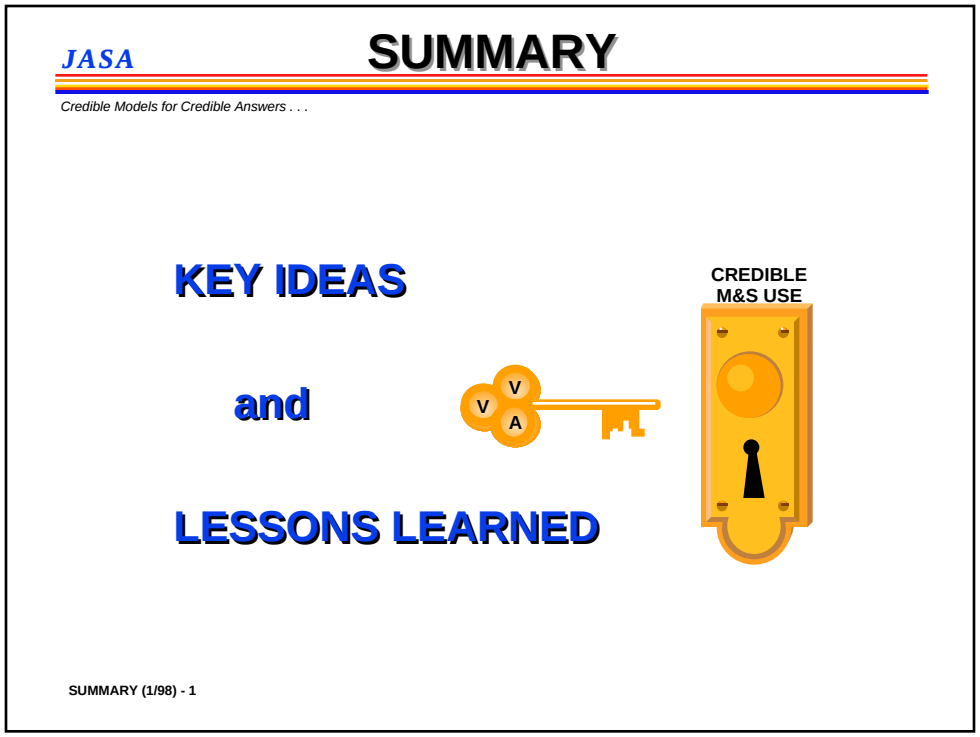

The foregoing presentation material covered several ideas and concepts for planning and performing V&V such that it is both cost-effective and focused on justifying accreditation. Because the entire VV&A process builds on traditional software V&V practices and yet is integrated into a purposeful effort that should extend to all M&S users, it may be easy to lose sight of the principle ideas and key concepts that are the foundation for this total approach. This section is meant to summarize the key ideas already covered and highlight the lessons that we have learned in applying these concepts to a variety of programs.

JASA

KEY IDEAS

Credible Models for Credible Answers . . .

- **COST-EFFECTIVE ACCREDITATION REQUIRES:**
  - > Complete problem definition
  - > Clear application description
  - > Explicit statements of M&S requirements
  - > A well-planned and focused M&S assessment effort

- **EFFICIENT V&V TO SUPPORT ACCREDITATION REQUIRES:**
  - > A clearly defined application context to permit focused V&V efforts
  - > A way to determine what V&V is NECESSARY to support accreditation
  - > A clear understanding of how each V&V data element contributes to M&S credibility
  - > A means of extracting key accreditation support information from software V&V (and other M&S) efforts
  - > An efficient means to produce, document, and archive all V&V information (from software and M&S V&V)

SUMMARY (1/98) - 2

The primary concept to remember is that VV&A is not a single step in the model development process. It is really divided into two distinct sets of activities: accreditation and V&V. Accreditation is done each time a model or simulation is used for a new and different purpose. The accreditation decision must be based on an objective comparison of M&S capabilities and features against M&S requirements for a particular use. Such a comparison depends on a complete definition of the problem to be addressed, a clear description of what parts of the problem will be addressed using M&S (the application), explicit and definitive statements of requirements that the model or simulation must meet, and a well planned method or process by which all the information will be collected, compared with requirements, and judgments made about M&S suitability. This last step is the assessment process that should generate the rationale to support the accreditation decision.

The set of activities that support the individual accreditation efforts is the composite of all V&V activities related to the selected M&S. Normally, these are directed V&V meant to generate information about specific aspects of the model that are important to the particular application. (For models under development where VV&A is meant to address the entire life cycle of the model, the V&V may also include traditional software V&V done as part of development.) In order to generate V&V information that supports accreditation, it is necessary to have a clear application context for focusing validation efforts. It is also necessary to know what types of information are needed and how each different piece contributes to credibility. One also needs to have a way of extracting important information from software V&V results and documenting all the information so that it is readily usable by those doing the accreditation assessments.

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LESSONS LEARNED

Credible Models for Credible Answers . . .

FIVE KEYS TO COST-EFFECTIVE VV&A

- **THESE KEYS ENCAPSULATE**
  - > How to look at VV&A
  - > How to turn VV&A into a cost and risk management tool
- **DEVELOPED FROM JASA EXPERIENCE WITH MAJOR DOD PROGRAMS**
- **EMBEDDED IN CURRENT JASA VV&A DOCUMENTATION**
  - > "V&V from A to Z"
  - > "How to VV&A Without Really Trying"
  - > Available on JASA Home Page (http://www.nawcwpns.navy.mil/~jasa)
- **SHOULD BE ADDRESSED IN NEXT VERSION OF DMSO VV&A RPG**

SUMMARY (1/98) - 3

In pursuing any VV&A effort, a primary concern is to conserve funds by making the effort cost-effective. There are five key ideas that are the foundation of the entire VV&A process we have described in this tutorial. They provide a way of looking at the VV&A problem and leveraging required products and processes to gain benefits that extend beyond mere compliance with directives. These benefits include a better understanding of the fundamental problem risks and a means of controlling VV&A costs.

These ideas have evolved during the past 6 through JASA's work on a variety of programs that were trying to address a VV&A problem related to their use of M&S. These ideas underlie the process and methods that are documented in the JASA publications on VV&A that are available through the JASA homepage or by contacting JASA. These ideas and processes are to be addressed in the next revision of the DMSO VV&A Recommended Practices Guide which should be published in 1998.

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KEYS TO COST-EFFECTIVE VV&A

Credible Models for Credible Answers . . .

MAINTAIN PERSPECTIVE

- **UNDERSTAND THE RELATIONSHIPS BETWEEN**
  - > The problem being solved
  - > The role of M&S in the problem
  - > The role of VV&A in establishing M&S credibility

- **REMEMBER WHY AND HOW YOU'RE USING M&S IN THE FIRST PLACE**
  - > Makes everything else easier
  - > Provides context for trade-off analysis

- **PERSPECTIVE EXAMPLE: THE DMSO VV&A RPG**
  - > Provides a widely applicable conceptualization of the problem-solving process
  - > Clearly shows the important relationships
  - > Provides over-arching context for all M&S-related activities

SUMMARY (1/98) - 4

The first important idea to adopt is that one must always maintain a real perspective about the problem. When someone is up to there neck in murky water it's easy to forget that the objective was to drain the swamp. So too, when someone is in the midst of a lot of detailed questions about V&V techniques, plans, and reports, it is important to remember the real objectives and to make decisions in light of those objectives.

The right perspective is a recognition that VV&A is only a tool to build the credibility of the models being used. The models, in turn, are only tools that provide information which will be used for some purpose - probably to reach some decision. The whole purpose of using M&S is to gather or generate this information more simply and easily than with some other technique. This perspective is clearly evident in the DMSO VV&A RPG.

In addressing detailed VV&A issues, any questions should be resolved in light of this perspective. The program level benefits of any particular course of action should be readily apparent. If not, the proposed action is probably not warranted. By adopting this type of perspective when addressing the multiple VV&A decisions, a VV&A manager can be assured that the final VV&A program will be cost-effective.

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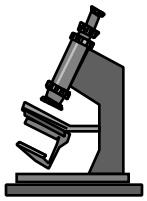
KEYS TO COST-EFFECTIVE VV&A

Credible Models for Credible Answers . . .

KEEP YOUR EYE ON THE BALL

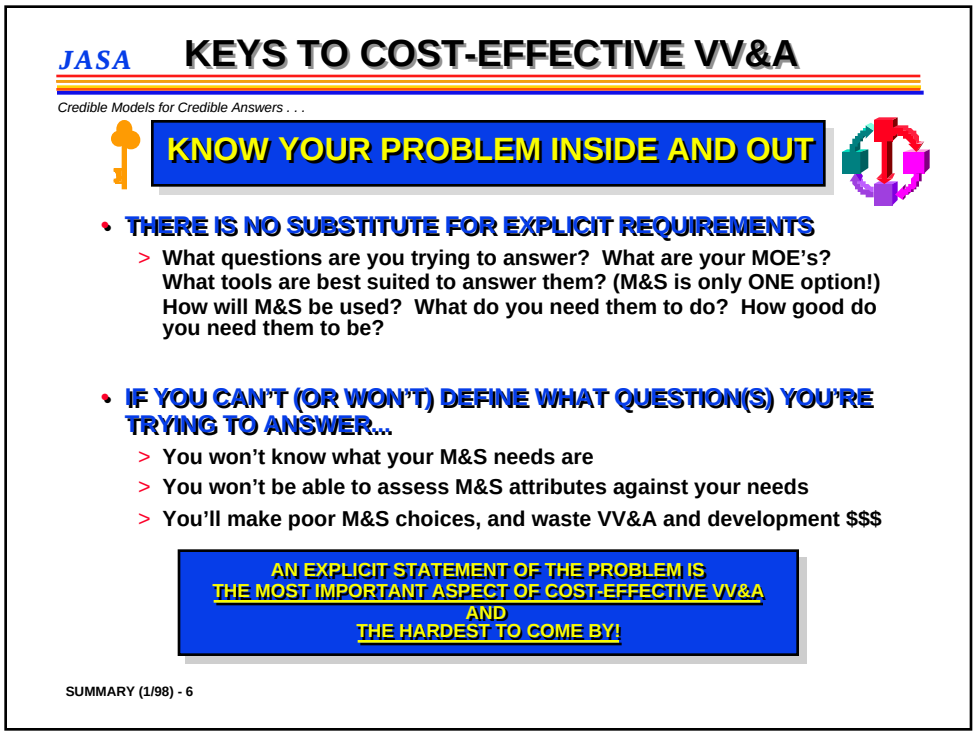
- **IT'S VERY EASY TO LOSE THE FOREST FOR THE TREES**
  - > **You forget why you're doing VV&A**
  - > **You forget why you're using M&S**
  - > **You forget how M&S relates to the problem**
  - > **Result: The model becomes the problem!**



- **MAINTAIN A PROBLEM ORIENTATION**
  - > **Your goal is to solve the problem; not build a model, not do V&V**
- **FOCUS ON ACCREDITATION**
  - > **Don't do anything that doesn't directly contribute to M&S credibility for your problem**

SUMMARY (1/98) - 5

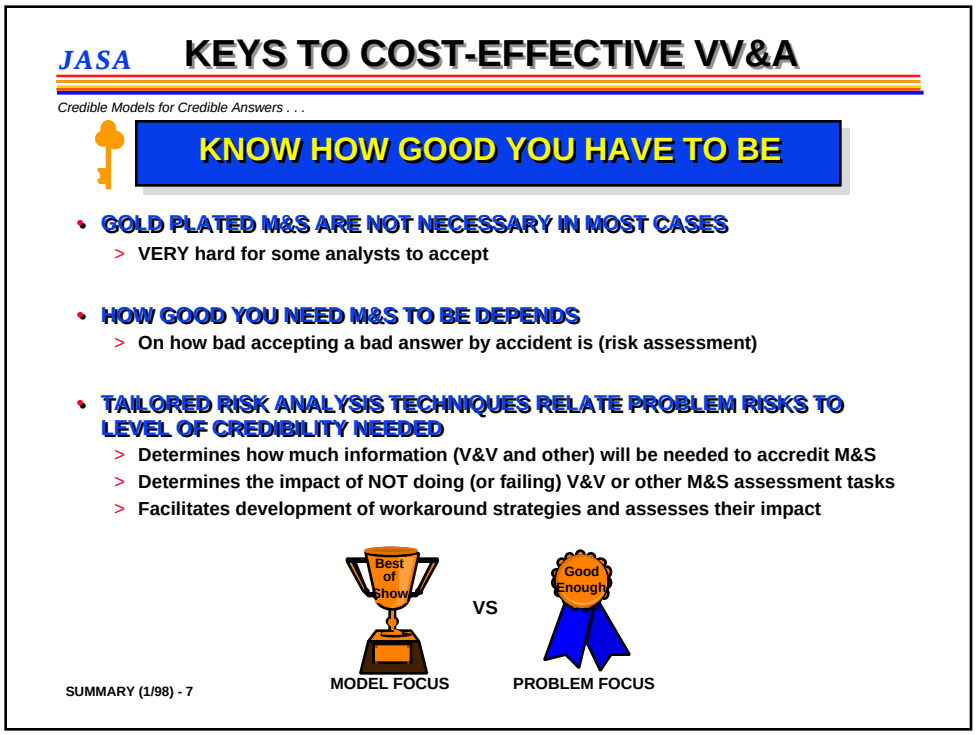
The second idea is to keep focused on your real objectives. It is very easy to become so wrapped-up in the details as to loose sight of the big picture. One Naval Postgraduate School professor who lectured on bureaucracy termed this the Means-End Inversion problem. It's easy to loose sight of the fact that the M&S is only a means of gaining information about the problem and that V&V is a means of gaining information about the M&S. If this happens, getting the V&V done becomes the focus of the efforts or the goal. The end result is that resources are spent to put out a good V&V product with little consideration as to whether that V&V product and supporting effort is really necessary for enhancing M&S credibility for this problem.



The third key idea is a natural outgrowth of the first two. It is to thoroughly know your problem. One cannot make VV&A decisions based on a problem perspective unless the problem is fully understood along with all its ramifications. One must know the basic problem issues; the information that is needed to resolve these issues; how accurate this information needs to be; the potential effects of erroneous information; the metrics to be used to quantify the information; etc. No list of topics will necessarily be complete. It is up to the people involved in the VV&A process to fully explore the problem and ferret out all the information that will be useful in making any VV&A related decision.

If one doesn't take the time to explore and understand the problem and how the M&S will be used to resolve it, one will not be able to make intelligent decisions related to the role of the model. Without an understanding of the M&S role, neither the required functions of the model nor the credibility requirements will be known. Consequently, one cannot make sound decisions about what model is most suitable and what information is needed about the model to ensure credible outputs for this problem. As a result VV&A dollars will most likely be wasted or there will be insufficient information on which to make a rational accreditation decision.

It should be obvious that a clear, explicit, and detailed problem statement is essential to ensure that people making the VV&A decisions fully understand the problem.



Besides knowing the problem, one must also know how good the model must be to satisfy problem requirements. This is the fourth key idea that underlies cost-effective VV&A. It is a natural follow-on to the last idea, knowing the problem. No model represents the real world perfectly. Some models attempt to be very realistic and precise. However, for many problems, such realistic models are an over-kill. It is important to understand just how realistic the model used in a particular problem must be.

Similarly, one does not need reams and reams of data about the model to prove its accuracy and degree of realism. In many cases, some degree of risk that the model might have some undiscovered deficiencies is acceptable. Many program decisions are made with less than perfect confidence that the model outputs have a certain level of accuracy.

The person making VV&A decisions needs to know what level of accuracy is needed for the problem and what level of confidence the manager making the decision desires. A good risk assessment analysis of both the problem risks and the risks of a bad decision are necessary to determine just how much information is needed at each step in the process to be “good enough”.

JASA **KEYS TO COST-EFFECTIVE VV&A**

Credible Models for Credible Answers . . .

BE A SMART BUYER

- **NOT ALL "V&V" SUPPORTS "A" TO THE SAME EXTENT**
  - > Know how much and what kind of credibility each type of M&S information buys you relative to its cost to produce
- **TRY TO AVOID (RE)DOING IT ALL YOURSELF**
  - > Capitalize on existing VV&A information whenever possible
    - » For Army-specific applications, consult Army M&S Catalog (AMSCAT)
    - » JASA also has VV&A documentation on 12 M&S of all types used in acquisition, with 7 more in progress
  - > Know how to extract useful data from software V&V results
- **GREATLY FACILITATED BY USE OF COMMON VV&A DATA ELEMENTS AND REPORTING STRUCTURE**
  - > JASA has developed and successfully implemented one approach

SUMMARY (1/98) - 8

The last key to cost-effective VV&A is being a smart buyer. The VV&A practitioner must recognize that all V&V results are not equally useful and informative when it comes to making the accreditation decision. There are many different purposes and techniques for doing V&V, especially between model developers and model users. The "smart buyer" understands these differences and just what credibility enhancements are provided by the different types of V&V activities. The smart buyer selects those activities that provide the minimum amount and type of data on which to base a rational accreditation decision.

Another way that one can be a "smart buyer" is to leverage previous V&V work done by the model developer and previous M&S users. In many cases, this work may be documented but the documentation will not specifically identify pieces of information that is being sought by the user. This type of problem can be overcome if the user understands how the necessary information can be extracted from existing reports.

As a means of overcoming this type of problem, JASA has developed a common VV&A data reporting structure to facilitate both V&V reporting and the location of desired data. Although the JASA reporting structure has been documented and used, it is not the only one that will support data reuse. Any common structure that is followed by several users in a single community will aid the smart buyer in locating and using existing V&V results.

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PARTING SHOTS...

Credible Models for Credible Answers . . .

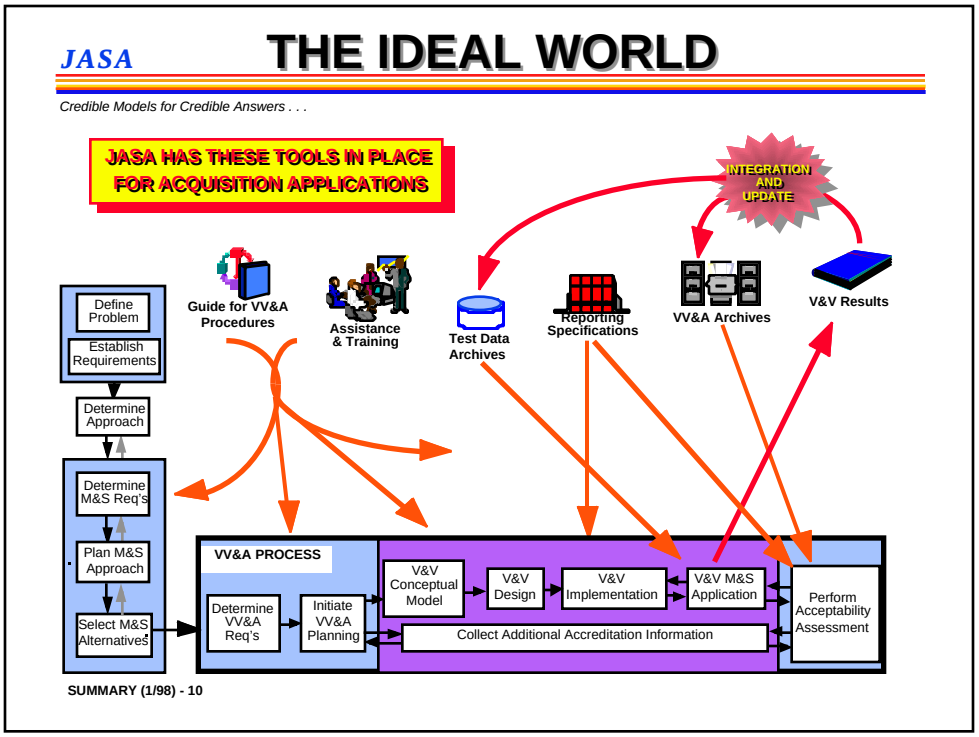
- **TAKE VV&A SERIOUSLY**
  - > Treating VV&A as a mere "administrative problem" reduces its effectiveness as a risk reduction tool
  - > Clear, well documented and supportable rationale for accreditation is the only hope for overcoming political and financial roadblocks
- **DON'T LET THE MODEL BECOME THE PROBLEM!**
  - > Focus on application-specific requirements for credibility
  - > Focus on M&S functions related to critical problem elements
  - > Evaluate every apparent set-back in terms of its impact on problem risks
- **IF YOU'RE NOT AIMING V&V AT A, YOU'RE WASTING YOUR MONEY**
- **CAPITALIZE ON EXISTING INFORMATION AND EXPERTISE**

SUMMARY (1/98) - 9

In summary, there are a few "words-to-the-wise" that encapsulate the lessons JASA has learned over the past several years. The first is to take VV&A seriously. One who treats it like an administrative "check-in-the-box" will probably end up throwing money at the problem, contracting out the work, and failing to get a satisfactory product. The wise VV&A practitioner sees the real value of VV&A, manages the activities to generate an adequate rationale to justify accreditation, and has the ammunition to overcome political and financial roadblocks related to the use of model data in a particular problem.

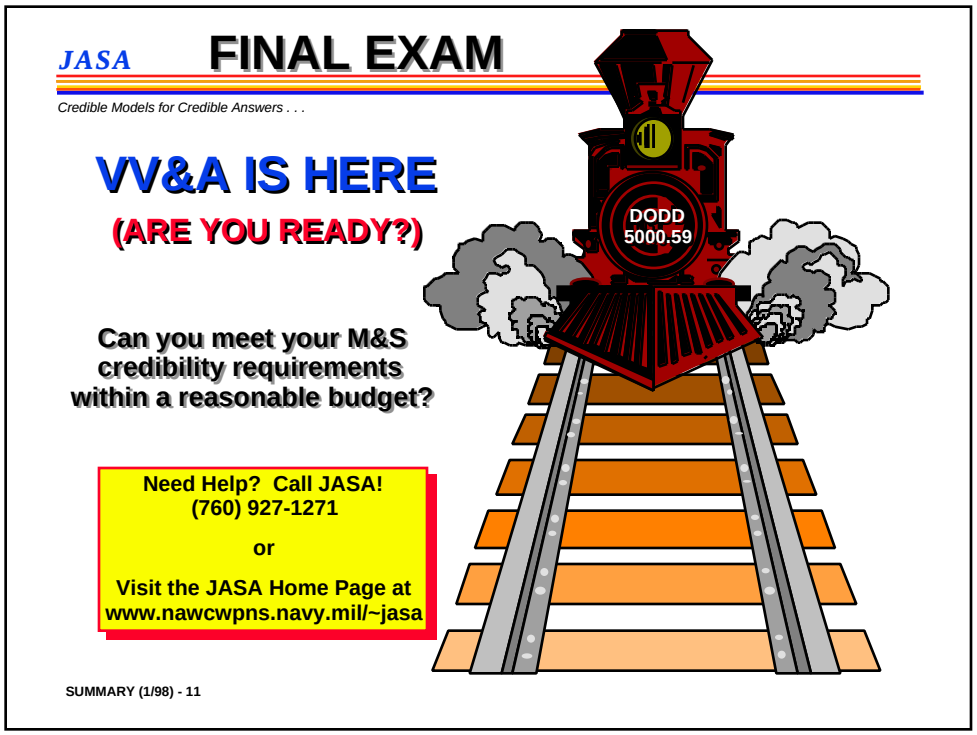
Another cautionary note is to avoid letting the model become the problem. A focus on the real problem and how the model results are to be used will help one understand the real effects of any model or V&V deficiencies. Such an understanding will lead to good decisions about what model deficiencies to correct and what additional V&V to undertake. Without this problem view, decisions may be influenced by many other factors leading to wasted resources.

In pursuing V&V it is important to remember that model accreditation for this problem is the goal. All V&V activities undertaken by the user should be directed at producing some piece of information needed to justify the accreditation decision. All other V&V work, although nice from the model developer's perspective, is wasted. Furthermore, the wise V&V practitioner seeks out and tries to make use of all past work. Only where there is insufficient existing information, should additional V&V work be done.

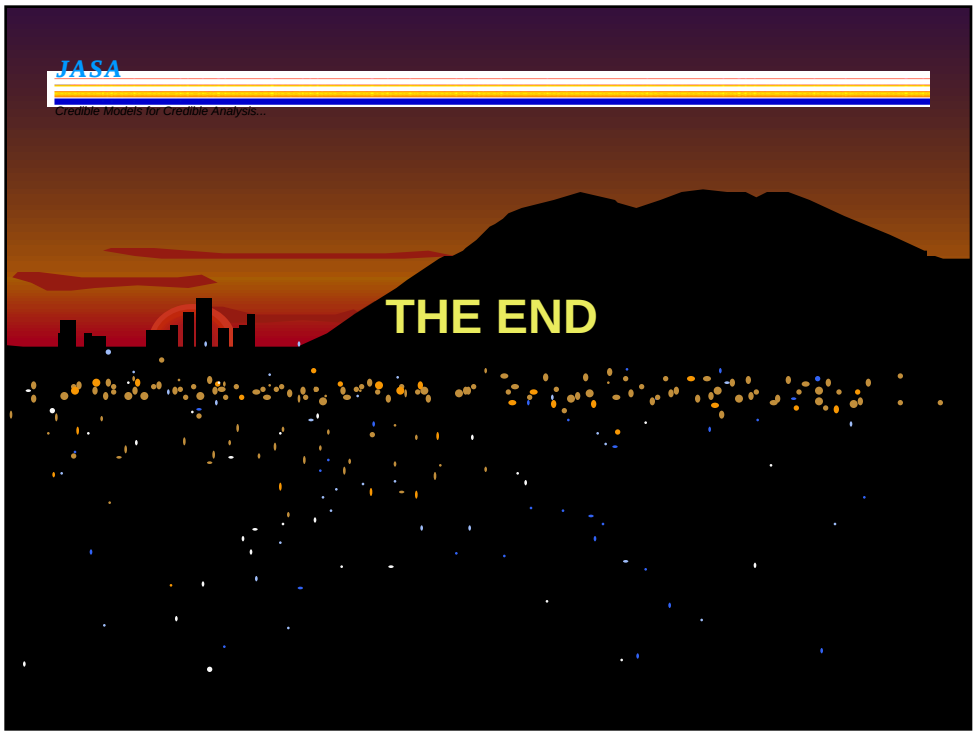


In an ideal world where all users followed the principles outlined in this tutorial, users would share information about a particular model. They would benefit from a support infrastructure that provide each user with common elements of support. The infrastructure elements would be used in different steps within the VV&A process as indicated here. Such an infrastructure makes data available, thus minimizing the chance of duplicative work, provides guidance on how the process can be adapted to individual needs, and, if desired, assists in actually implementing the process. The existence of such an infrastructure would lead to increased employment of these principles, to standardized reports, and to greater data reuse.

The Joint Accreditation Support Activity presently fulfills this role.



This tutorial should also have convinced you that the entire issue of VV&A is one that cannot be ignored. From both a practical point of view and to comply with policy direction it is important to know how to determine minimum requirements, perform effective V&V, and build a logically sound case to support an accreditation decision. You the user either are or will be facing the need to implement a VV&A program. The question is: “Are you ready?”.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Credible Models for Credible Analysis...
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